

Fiscal Year 2020 NASA Budget Request Media Teleconference

Speaker:

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Moderated by

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5 p.m., ET

Monday, March 11, 2019

OPERATOR: Welcome, and thank you for standing by. At this time, I do want to inform all participants that for today's call, you will be in a listen-only mode until the question-and-answer session. Today's call is also being recorded. If anyone has any objections, you may disconnect at this time. And now we'll now turn the call over to your speakers. You may go ahead.

ALLARD BEUTEL: Good afternoon. This is Allard Beutel with NASA's Office of Communications, here at NASA Headquarters in Washington. Thank you for joining us for this Fiscal Year 2020 NASA Budget Request media teleconference.

We are joined here today by NASA's Chief Financial Officer, Jeff Dewitt; the Deputy CFO, Andrew Hunter; and Senior Budget Analyst, Brian DEWHURST.

As a reminder, all of our budget material is available on nasa.gov/budget, and it includes the chart that Mr. Hunter will be going through momentarily. And you can also watch on nasa.gov/live as we go through the presentation and see the slides, as well as the teleconference.

We'll start off now with talking to Mr. DeWitt.

JEFF DeWIT: Thank you. Thank you very much.

Let me start by saying that this is a great budget for NASA. The President's proposal of \$21 billion represents an increase over last year's request and comes at a time of constrained resources across the Federal Government. It emphasizes the priorities the administration places on NASA's mission and America's future in space, and NASA very much appreciates the commitment of President Trump and Vice President Pence to our mission.

This proposal is an important next step in meeting the President's directive in Space Policy Directive-1 to "lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system."

NASA appreciates this administration's recognition and support of the valuable impact of the agency, not only on scientific discovery and technology development, but also on the U.S. economy and quality of life of all Americans and people around the world.

We also very much appreciate the strong bipartisan support that we have up on the Hill in Congress. NASA is not on a single mission. We're creating the backbone for a permanent human presence deeper in space, to the Moon, and eventually to Mars and beyond.

The Budget Proposal fully funds NASA's Space Launch System and Orion spacecraft to continue work on Exploration Missions 1 and 2. It supports work over multiple elements of the Lunar Gateway and our continued progress with commercial space in low-Earth orbit and on to the Moon with new human scientific research and cargo lander systems.

This Budget Proposal also supports the ambitious program of Solar System exploration that includes the Mars Sample Return Mission and the launch of the James Webb Space Telescope as well as development of the critical technologies required for humans to successfully operate on a lunar surface.

The Fiscal Year 2020 budget provides for the continued development of a Supersonic X-Plane that will demonstrate quiet overland supersonic flight enabling U.S. industry to open a new market as well as continued work in transformative aeronautics research and efforts to make air travel safer and more efficient.

Overall, the President's Budget Proposal puts us on strong footing to continue leading the world in exploration with commercial and international partners playing a critical role as we seek to bring new knowledge and opportunities back to Earth.

With that, I'm going to turn this over to my Deputy Chief Financial Officer of Budget, Andrew Hunter, who will walk us through the numbers.

ANDREW HUNTER: Okay. Hi, everybody.

I'll go through the charts relatively quickly to allow enough time for Q&A for anything not covered, and just another note, the detailed congressional justification budget book will be coming out next Monday with much greater detail on all of these programs and projects.

So, as Jeff said, this is a strong budget. It lays the framework and sets in motion activities that will put Americans back on the Moon in 2028 and build capabilities to eventually put humans on Mars.

Chart 2 talks about the Space Policy Directive-1 as being our guiding principle here. This directive was codified in last year's President's Request and lays the foundation for this one as well, so continuity.

Chart 3, this budget has several firsts, Exploration Firsts through 2024, and starting from the left, our Commercial Crew program with its successful splashdown of Dragon last Friday morning. That kicks it off, eventually getting humans up to the Space Station later on this year with Boeing's SpaceX. We've got the Commercial Lunar Payload Services activity to deliver science and tech payloads to the moon. That's otherwise known as CLPS, the second column there. EM-1, along with EM-2 and EM-3, are SLS and Orion flights. More on that shortly. I'll talk about that. Mars 2020 on track for launch next year. And then we have the first element launch of the Gateway, our Power Propulsion Element in 2022. That's on a commercial ELV. All the Gateway elements will be on commercial ELVs. We also have Enhanced Science and Exploration Mobility Capabilities. We will see rovers on the Moon as soon as 2023. Then we have our next Gateway element with Espirito Santo, the European-provided Espirito Santo, and Utilization Module in 2024 time frame. That will enable finally a crew to stay aboard the Gateway. And then we have the EM-3 mission, the first crewed mission to the Gateway. Then, finally, in 2024, we're planning a series of Lunar Lander Demonstration Missions with the first uncrewed mission testing, human descent capabilities on the surface in 2024, and you'll see a Lunar Lander Descent Module Demo there. So a lot of activity over this budget horizon.

Next, Chart 4. Again, this is a strong budget, \$21.019 billion. This is about \$1.4 billion above the '20 column in the '19 budget in the President's Request, so it's a substantial increase. For the first time, it actually does include inflation growth. So that is built into the out-year budget here of 1 percent inflation growth a year. That, as you probably are all familiar, is something new. We've seen notional budgets, flat-line budgets the last 7 years. So this is a good sign that the administration is very serious about growth for the Exploration Program.

It is \$500 million below the '19 enacted level that Congress has enacted. This planning, of course, was started well before we got an enacted budget in February, and we also have several elements in this budget in '20 that are not continued from the enacted levels in '19, including WFIRST, a couple Science Missions, and the STEM education activity. So that explains some of the difference between why we are slightly below the '19 enacted level.

However, we do include \$10.7 billion to continue building the key components of the Exploration campaign, which consists of the critical backbone elements of our future in Deep Space, and that is the Space Launch System rocket. Getting EM-1 and EM-2 launched as fast as technically possible is a prime objective of this budget, something that more money will not accelerate. This is technically a technical condition in terms of getting there faster, and so we are not asking for more money for SLS to do the job. We just need a little more time.

We also have the Orion Crew Capsule, which will be on top of the SLS, and both of these elements together will be critical to deliver humans to the Gateway. Then we also have the Ground Support System that supports those three elements all together, working together.

The Lunar Gateway is an outpost orbiting the Moon. We'll see that in the mid-2020s. The first element is the Power Propulsion Element being launched in '22, with the Esprit and Utilization Module in '24. Then later on, you'll see beyond the budget horizon, we'll have future habitation modules and logistics capacity as well.

The Commercial launch capabilities to enable regular, low-cost access to the lunar vicinity and surface, this is through our Commercial Lunar Payload Services, the CLPS activity, and then finally, we have about \$363 million starting in '20 for activity to enable Lunar landers and human access to the lunar surface by the late 2020s. And that number will actually grow to about \$2.3 billion in 2024 in our Advanced Cislunar and Surface Capabilities program.

Finally, around all this, wherever possible, we'll be leveraging, building on commercial and international partnerships as we go forward. This program will get us back to the lunar surface the soonest.

Next, Chart 5. As I said, develops the first elements of the Lunar Gateway, the PPE, ready to launch in 2022. We'll have a contract planned for award later this year and the Utilization module and Esprit enabling crew to stay aboard starting in 2024. Gateway will all be launched on commercial launches, and we have about \$820 million aligned in the '20 budget for the Gateway activities.

We also are using the growing emerging technology and commercial capabilities to deliver science and technology payloads to the Moon. Back in November 2018, we had Commercial Lunar Payload Services contract and selected nine companies, among them making them eligible to provide transportation services, and in February 2019, NASA selected 12 NASA payloads that could be flown on early CLPS missions. So that's all primed and ready to go for commercial providers to deliver to the Moon.

Then, finally, this budget focuses the SLS program on the completion of the initial version of SLS and supporting a reliable annual SLS/Orion flight cadence. The focus is on EM-1, getting that right. We've had schedule challenges with the core stage. We've having an assessment under way to get to a realistic launch readiness date, and that will be later in April and later in spring when we will have a declaration of a launch readiness date for EM-1. In the meantime, EM-1, -2, and -3 will be using the Interim Cryogenic Propulsion Stage, and the budget will defer the EOS Block 1B activities.

On Chart 6, we have the Lunar Surface Innovation Initiative. There's about \$50 million in the budget for this, and this will serve as a catalyst for enabling critical technologies required for humans to successfully operate on the lunar surface. This technology holds potential to produce consumables, including oxygen, water, and hydrogen from the Moon in the in situ resource utilization activities. It also includes surface power generation. In FY '20, we have a fuel power project to demo small lightweight efficient power systems, so a lot of interesting work going on there.

We are also utilizing public-private partnerships to develop a human-class lunar lander that will reestablish our preeminence to, around, and on the lunar surface, leading to a human lunar landing by 2028. That is the \$363 million that grows to several billion dollars in the out-years in our Advanced Cislunar and Surface Capabilities program, and in our planetary lunar discovery and exploration activities, we are developing lunar robotic rover capabilities to support science and resource utilization. These all work together. You've got the rover work being done in Science. You've got the CLPS activities being done in Planetary Science. That's leading to new technology and feeding knowledge and technology into developing mid-size and eventual human-class lander systems. So these will all be working together with commercial and international partners.

Then, finally on this page, administration policy still stays the same regarding ISS, looking at commercial use and operations of Space Station, when eventually we become the customer, but we've still got \$1.458 billion to operate the Space Station and provide the science that we need from that Space Station on the effects of humans in space, and we will be continuing to facilitate a transition to a more robust and cost-effective approach to human space activities near the Earth.

Page 7. A very robust science program still continues. We've got quite a bit of activity here with the next Mars rover launch in July 2020 and a Europa Clipper mission to launch in 2023 on an EELV. We did not fund the Europa lander in this budget, as we didn't last year either. We've got \$592 million funded for the Europa Clipper. We also are initiating a Mars Sample Return to retrieve samples from Mars, and those samples would be cached by the Mars 2020 vehicle, and then we'll return those samples with the first launch from another planet, which is pretty cool. That's one of the highest Decadal priorities as well.

We continue exploring the universe with the launch of the JWST telescope in March '21, and this budget, like last year, provides no funding for WFIRST while the Webb is still being built. The dollars aren't there, and while the science of the WFIRST is exceptional, it is a priority decision and dollar availability issue at this time.

We continue the work of 10,000 scientists across our science programs and over 3,000 competed awards, so world-class science network and research output is un-comparable across the world.

Consistent with prior budgets, we provide no funding for PACE, the Plankton, Aerosol, Cloud, and Ocean Ecosystem project, and the CLARREO Pathfinder. And, similarly, last year and the year before, the Office of Science, Technology, Engineering, and Mathematics, STEM, engagement is zeroed out, the funding for that.

Chart 8. We have a strong aeronautics program. The X-Plane designation that was finally given to the low-boom flight demonstrator, and it's called the X-59 QueSST. That has a launch readiness date of 2022, and that's funded \$130 million. It will revolutionize the way we travel across this continent in terms of the speeds.

We also maintain a robust investment in air traffic management improvements, unmanned aircraft systems, and air traffic capacity technologies, et cetera.

We also have made a strong effort in this budget to replenish resources for mission-enabling activities and operations and are seeing a fairly significant increase in our Safety, Security, and Mission support line. We are prepared to go back to the Moon, and the last time we went to the Moon, this agency had substantially much more money to do that. And we've made a commitment to the infrastructure of this agency to enable exploration to occur as well.

Then Chart 9, just a few accomplishments in 2020. Gateway, we'll see contracts there, and that will start its development activities, its planning and formulation activities. We continue the delivery of hardware for integration and testing for the upcoming EM-1 and EM-2 launches. The James Webb Space Telescope, we will continue testing integration on schedule for March 2021 launch. We are on top of our Commercial Lunar Lander capabilities to delivery payloads to the surface of the Moon. We have healthy competed lines in our New Frontiers, Heliophysics, Small Explorer, Astrophysics Medium Explorer, and a suite of Earth Venture Suborbital-3 investigations, so a lot of activity in science. And then Commercial Crew, Boeing and SpaceX, are on course for certification of their transpiration systems later this year. Then quite a few critical technologies will be demonstrated in Exploration Technology, laser comm, MOXIE, the Mars Environmental Dynamics Analyzer, MEDLI2, Terrain Relative Navigation, Astrobee, and Lunar flashlight are a couple of spacecraft that will be launched as well. Then we complete the Solar Electric Propulsion CDR and start the Lunar Services Initiative as well. Then in thermal, we are accelerating research supporting the Urban Air Mobility activity.

Chart 10, the numbers. 2019 are the enacted levels called out in law. We haven't filled all the items in because we're undergoing an operating plan process right now to fill in numbers that weren't specifically called out in law, but you can see that there is inflation in the out-years at 1 percent a year.

A couple things I'll just point out in case there's questions about it, Aeronautics appears to go down, but that is we are transferring the aero sciences evaluation and test capabilities, the wind tunnel activity there, to the Safety, Security, and Mission Services account. There's about \$65 million a year that comes out of Aeronautics to SSMS.

Then the construction of facilities line looks high in 2020 and goes down. That's because we have about \$90 million that comes from the mission directorates for program-specific construction, and the CoF line is the only place we can execute those funds. So there's always a little growth in the budget year for construction of facilities, and then it goes back down to its regular institutional levels.

Chart 11. Here's the visual for the full Exploration campaign funding. The top blue is our Exploration R&D. That includes AES. That includes all the Gateway activities. That includes the Advanced Cislunar and Surface Capabilities and our Human Research Program.

The next sledge there is the orange, is the Exploration Systems Development line. That's where Orion, SLS, and Ground Support are budgeted, and then we have the Exploration Technology, the blue line below that, the tech maturation and tech demo activities. And then the big green is the low-Earth orbit and Space Operations account, where we have ISS, crew and cargo space transportation, space and flight support, commercial LEO development, and launch services, things like that. And then science below, which includes Mars Sample Return and the Lunar Discovery and Exploration Program.

You can see an inflection point in '23, '22-'23, where the Exploration R&D grows a little bit more, and we are intent on driving down some of the operations of the LEO and Space Operations line in the out-years.

Next chart is the one that we put together to show that we weren't going out of business after Shuttle. We keep saying that every year, but we have a lot of activity ahead of us here, and in '19, we just checked off the EM-1 demonstration. That successfully splashed down Dragon capsule on Friday. That was just checked off this weekend. And I won't go through all of these, but you can see there's quite a bit on the manifest here, especially commercial and science. You can see EM-1 and EM-2. You can see the Lunar Exploration Mission of Opportunities tied to the CLPS activities, et cetera.

Thirteen. I'll go through these pretty quick here and highlight what I haven't talked about yet, but this funds SLS, Orion, and EGS, and it enables humans back to the vicinity of the Moon in 2023 with EM-2 launch. Orion is \$1.266 billion, SLS is \$1.775 billion, and Ground Systems is \$400 million, a lot of activity enabling those three elements to come together to form the backbone of our future in Deep Space.

Next chart, Exploration Research and Development. This is where we have the Advanced Cislunar and Surface Capabilities line. This will be the line that grows substantially in the out-years. We're starting at \$363 million to develop—laying the framework and groundwork for developing reasonable human lunar landing architecture. And then the Gateway elements are in here for \$821 million, and I mentioned that earlier. AES looks at habitation capabilities and systems, crew mobility systems, vehicle systems, autonomous systems, things that feed into future development activities, and then the Human Research Program is included in this line as well.

Fifteen, Exploration Technology. This is basically the same technology program of previous years, with a greater focus on lunar surface activities and the technology required to support humans on the lunar surface and support Mars "tall pole" technology needs. We have also the Laser Communications Relay Demonstration funded here for the 2020 launch date, several small spacecraft for flight, and then this is where we also develop the Solar Electric Propulsion for the Lunar Gateway. And the first demo will be 50-kilowatt class activities. This is also where we fund the SBIR and STTR activities.

Sixteen, International Space Station. We've got about \$1.1 billion for ops and maintenance, and research at about \$353 million, and this will continue. You can read the ISS focus areas not changing here, but we did recently award study contracts to industry to investigate the best way to use ISS to enable commercial industry to take a lead role in low-Earth orbit operations. Twelve companies are providing studies right now. We have \$225 million, I believe, for the commercial activity to support that—oh, I'm sorry—150 in 2020. And the concepts will detail business plans and the viability of habitable platforms using Station or separate free-flying structures, and this is a continuation of the activity last year to eventually be a customer of the Space Station rather than fully have the Federal Government support the operations.

Space Transportation on Chart 17. This is what we pay to our partners to deliver crew and cargo to low-Earth orbit. I don't think there's much more here, but this is the area that we're using to stimulate growth in the space transportation industry, available to all potential customers, and for reducing our dependence on Russian spaceflight capabilities for crew transportation.

Chart 18, Space and Flight Support. These are the foundational capabilities for human spaceflight, space communications, Deep Space tracking network, and the ground network, the SGSS sustainment project to modernize the network. The new thing on this page is we're initiating a Communications Services Program to begin purchasing commercially provided satellite-based data relaying services to more efficiently meet future needs. This is modeled on the Launch Services Program, and we're feeding it about \$300 million to start to see if there's a way we can do that more efficiently. Then we also support our crew health here, Astronaut Services, Launch Services Program, and also our rocket testing capabilities.

Nineteen. This is what I was referring to earlier when I was talking about Space Station, \$150 million in '20. We had \$40 million enacted in '19 for this activity. So it's continuing along the path of last year's budget, and the circle there shows potential areas under consideration that we could use commercial partnerships with to help support the Space Station operations in the future. So that's the same as last year.

On '20, Earth Science, we've got quite a bit of activity here, beginning the new Earth Venture Continuity element, \$33 million. We do propose to terminate the PACE and CLARREO Pathfinder, but we do restore funding for the OCO-3 and DSCOVR missions. A lot of formulation and evidence missions like Landsat-9, NISAR, SWOT, TEMPO, Sentinel-6, and the Earth Science activity supporting over 30 missions in all stages of development and operation. And you will see in all the themes that we have CubeSats/SmallSats that are supported in every theme, just because we are making substantial investment in CubeSats and SmallSats because we can just get so much more science for lower cost nowadays with technologies.

Twenty-one, we've got Planetary Science. We've got \$210 million continuing the Lunar Discovery and Exploration program. This is where CLPS and Lunar Robotic Orbiter, LRO, is budgeted as part of Exploration. Continuing the development of Mars 2020 and Europa Clipper, initiating a Mars Sample Return, as mentioned earlier, and then we continue the

Planetary Defense program, \$72 million for DART, the Double Asteroid Redirection Test, and Near-Earth Object Observations at about \$77 million. We've got Lucy and Psyche in development, and again, about supporting 13 planetary missions.

Astrophysics. Several missions and formulations in development listed here. SPHEREx is a new MIDEX mission just selected. Operating 10 missions here and the balloon program, supporting the TESS mission that was launched last year and the Hubble Space Telescope, now in its 28th year, being supported at \$83 million a year. We also have SOFIA budgeted here at \$73 million, and consistent with last year's request, we are also proposing termination of the WFIRST mission due to its significant cost at this time until we complete James Webb. We just don't have the budget to do that and the Exploration priorities.

James Webb. We've created this into its own theme again. It was under Astrophysics last year. This budget supports the new launch date of March 2021, applying the Independent Review Board and Standing Review Board recommendations, and it's getting ready for working with our French partner providing the Arion 5, and that's the launch vehicle for launch in Kourou, French Guiana, in 2021.

Heliophysics formulates the Interstellar Mapping and Acceleration Probe, IMAP. It develops a Solar Orbiter Collaboration with ESA, and that's readying for launch in 2020, and then ICON is readying for launch later this year. Then we have 16 additional missions, including Parker Solar Probe, which was launched last year.

Twenty-five, Aeronautics. This is where we did transfer ATC. \$65 million went to SSMS. So it's roughly comparable to the '19 levels that were enacted, and this completes the final assembly of the X-59 aircraft mentioned earlier and advances technology for the next generation of subsonic transport, including electric aircraft propulsion aircraft. A lot of research in urban air mobility to support industry readiness to perform advanced safety and operations testing for emerging global urban and inter-urban air mobility markets. That's pretty interesting stuff that they are doing there. Also integrating the larger unmanned aircraft systems into the national airspace is also part of the research.

STEM Engagement. Really, this story hasn't changed from last year, literally the same chart, the same proposals the last couple years, and the STEM Engagement dollars have been zeroed out; however, we do continue internships, fellowships, and student STEM engagement activities funded by NASA mission directorates. And SMD's Science Activation program will continue. I think that's at about the 45- or \$50 million level.

Then, finally, we have our Safety, Security, and Mission Services line. This is about \$300 million above the enacted '19 levels, and it also includes about \$117 million being transferred in for the AETC from various directorates consolidating the wind tunnels in one place to be managed. We do increase facilities maintenance to reduce the deferred maintenance backlog here. Remember, a lot of this infrastructure was built back in the Apollo program, and we're getting

NASA ready for the next generation of exploration. And we strengthen cybersecurity capabilities and the mission technology activities in this budget as well.

And last but not least is the Construction of Facilities and Environmental Compliance and Restoration. We have two buildings that are focused here, our Flight Electronics Lab at JPL and the Flight Dynamics and Research facility at Langley. This budget actually gets us to our facility replacement rate every 240 years instead of every 300 years. So it is some improvement, but it does let you know that we've got old, old infrastructure in this agency. And we want to revitalize what we can and replace and make modern where we can for every, I believe, two—what's the—

BRIAN DEWHURST: For every square foot we build, we try to knock down 2 square feet of—

ANDREW HUNTER: Yeah, the replacement rate.

BRIAN DEWHURST: —old inefficient space.

ANDREW HUNTER: Yeah. Brian got that right. Thank you.

And then to get off the stage chart, it's just a summary of what this budget will do, looking back by—in 2028, we'll have provided opportunities for at least 13 Deep Space CubeSat missions, including 7 to the Moon on EM-1; 2 Exploration Mission test flights with SLS and Orion; completed 5 EM flights on SLS and Orion; and flown up to 10 CLPS opportunities, delivered a rover to investigate volatiles on the lunar surface and demonstrated for the first time a reusable lunar ascent vehicle used for the first time on the Moon, key exploration technologies including precision landing, cryogenic fluid management, in situ resource utilization; and surface nuclear power and return humans to the lunar surface.

So those are the charts in pretty fast order, but we can open it up for questions.

ALLARD BEUTEL: Right. While we were going through this, we will take questions in a moment. The operator will walk people through it. I just want to say that while this teleconference has been going on unabated—and there hasn't been any issues with the media teleconference, the phone line you're using—[nasa.gov/live](https://www.nasa.gov/live), where we stream, we do an audio stream of this, was down for the first 15 minutes of the teleconference. So what we're planning on doing is for those who may have missed or have joined now or were waiting around for it to come up on the stream, we'll be posting a full uninterrupted recording of this shortly after the teleconference is done. So if you're on the teleconference, obviously you heard it. It was uninterrupted. Those who were listening at [nasa.gov/live](https://www.nasa.gov/live), we were not up for the first 15 minutes, and we'll post a full recording of that shortly after. I apologize for the server issue that we had.

So, again, we have a lot of reporters on the line. We do want to get to everybody's questions. Be courteous to your fellow journalists. So we can go one question at a time, so we can get

through as many as possible and go back around if we have time. I'll now turn this over to the operator to walk you through how you get to indicate if you do have a question.

OPERATOR: Thank you. On the phone line to ask a question, please press star, followed by 1, and please record your name clearly when prompted. Again, that is star, followed by 1 if you would like to ask a question.

ALLARD BEUTEL: Okay. We'll take our first question from Tariq Malik from Space.com.

TARIQ MALIK (Space.com): [In progress]—for planetary science, and forgive me if I missed it, but I was just curious exactly how much is allocated for the Mars Sample Return Mission itself, and is it dovetailed closely with Mars 2020 or still building on the initial capsule sample return technology that had been preplanned for the mission? Thanks.

ANDREW HUNTER: Yes. We have \$109 million allocated in '20 for future Mars activities, the majority of which would be applied to the Mars Sample Return Mission to begin early formulation there, and yes, that would be dovetailed with the Mars 2020, which would deposit a cached samples so that the Mars Sample Return would retrieve.

ALLARD BEUTEL: Okay. Our next question will go to Eric Berger, Ars Technica.

ERIC BERGER (Ars Technica): Hi. I'm just curious about how long you plan to defer development of the Exploration Upper Stage. If you're going to not need it for co-manifesting the Gateway Modules, it seems to me like you wouldn't need it for quite some time. So maybe you could talk a little bit about when you think NASA will actually need the Block 1B capability for SLS. Thank you.

ANDREW HUNTER: Yeah. I'm going to let Brian do that. You're right. We won't need co-manifesting for the Gateway. We won't need EUS for a while. While we will continue working on EUS in '19 as it is in law that we do so, along with the launch platform, this budget does not assume—we won't need that until probably EM-4 period, time frame.

BRIAN DEWHURST: The focus is to get a consistent cadence of Block 1 missions up and running, delivering crew into the lunar vicinity. We will eventually need EUS, but we don't have a precise date for exactly when or which mission that will be at this point.

ANDREW HUNTER: Yeah. Getting the Espirit, the Utilization Module, the SLS Block 1 in operational mode, we can get to the lunar surface fastest in this way and with the least amount of dollars needed. Okay.

ALLARD BEUTEL: Our next question will go to Joel Achenbach, Washington Post.

JOEL ACHENBACH (The Washington Post): Yes. Thank you so much. I think you just answered the question. So the SLS would still be used in Orion for the Lunar program, correct? It's still part of that architecture?

ANDREW HUNTER: Absolutely.

JOEL ACHENBACH (The Washington Post): Okay. And you have how much? 300 and how much million for lunar landers in this budget?

ANDREW HUNTER: 380—63 in '20, but it quickly grows up to \$2.3 billion in '24.

JOEL ACHENBACH (The Washington Post): So where does that money come from, the \$2.3 billion in '24? I mean, typically, it's got to come from somewhere. It doesn't just materialize out of thin air.

BRIAN DEWHURST: So part of that is the growth in the out-years, and part of that is other development activities rolling off. Gateway will largely be done in its development phase by that point, and so we'll be taking those dollars and ramping up ACSD with them as well.

ANDREW HUNTER: And there are some out-year assumptions regarding ISS in '23 and '24 that we're going to have to go off and work in consecutive budget cycles.

ALLARD BEUTEL: Our next question will come from Marcia Smith, SpacePolicyOnline.

MARCIA SMITH (SpacePolicyOnline): Thanks so much. Going back to the Mars Sample Return, what is the out-year prospect for that? How much is the total program costing? Where is that money coming from within Science?

ANDREW HUNTER: We're frantically looking at the numbers here, Marcia. Bear with us. Yeah. We've got a wedge that grows 200, 300, 400, up to \$400 million a year in '23 and '24, so—

BRIAN DEWHURST: I'd say we're just beginning to formulate and intend to launch by the end of the 2020s, but we don't have a precise commitment or anything yet. We just have the healthy wedge that Andrew just described that will get us on the way there.

ALLARD BEUTEL: Okay. The next question is Loren Grush with The Verge.

LOREN GRUSH: Hi. Thank you for taking my question. I'm just curious what all the available commercial options for launching Europa Clipper would be without SLS and how each one of those would change the length of the mission.

ANDREW HUNTER: The EELV Delta IV would be probably the prime candidate there.

BRIAN DEWHURST: And with the transit time, it would be a lot longer, at least 4 or 5 years as opposed to 1 to 2. I'd have to double check those exact times, but that's the trade is—

ANDREW HUNTER: Less cost but longer transit time.

BRIAN DEWHURST: Yeah.

ALLARD BEUTEL: Next is Mark Carreau with Av Week.

MARK CARREAU (Av Week): Thank you very much. In the last couple of years, there were appropriations for a second mobile launch platform for the SLS. What happens to that money and the project?

ANDREW HUNTER: In '19, we are continuing to build it. It's in law that we do so, so nothing is changing there.

ALLARD BEUTEL: Next question, Keith Cowing, NASA Watch.

KEITH COWING (NASA Watch): Yeah. A question, it seems like I've been asking for a couple, 3 years here about the education budget. It says in your charts that there will be no funding for the STEM Engagement Office, and yet other parts of NASA are doing education. Does this mean that the 100-or-so million dollars that is currently spent by STEM education, that goes away, and everything that it funded goes away, or does it mean that the directorate is going to cough up \$100 million to take over all of those activities?

BRIAN DEWHURST: No. It means that that \$100 million goes away, and we do not plan for it.

ALLARD BEUTEL: Our next question is Ken Change, New York Times.

KEN CHANG (The New York Times): Hi. Thank you. I was wondering if you had more details about the transition from ISS. Is that still scheduled for 2024? Are there any more details about how that will be done? And is the RFP for the commercial use of the port going out any time soon?

ANDREW HUNTER: The intent is that—we're obviously not going to shut down the Space Station, but the intent is that the Federal Government does not continue operating it, and that we are building this commercial program to look at opportunities for commercial industry and partners to overtake the operations, similar to last year. So we still have that commercial line in the budget to help us do so and to investigate the opportunities out there.

The last part of the question, I don't think I know the answer to, but we can ask the HEO Mission Directorate for the response.

BRIAN DEWHURST: Yeah. We'll have to get back to you after this.

ALLARD BEUTEL: This is a reminder. If you have—we had a number of people on the line. If you have a question, put in for it. Otherwise, we're getting near the end, and we don't have a lot of follow-up questions that the people have dialed in. So last chance at a bite at the apple. We have one more person right now. Kimberly Cartier with Eos magazine.

KIMBERLY CARTIER (Eos Magazine): Hi. Thank you for taking my question. Some of the lasting success and impact of some of the Apollo missions comes from the unilateral public support and engagement. How do you expect to achieve the same for your Moon to Mars Initiative without funding for STEM engagement?

ANDREW HUNTER: Right now, we would do it through our mission directorate activities, our outreach activities through the programs and projects. That's about all I can say. We do have a specific education component to the Science Mission Directorate, which reaches a lot of folks. So that's all I can sort of probably say on that.

We get a lot of information out there as an agency and through the social media, but I do appreciate your question. That's all I know about it.

ALLARD BEUTEL: This is the second round bite at the apple. We'll go with Eric Berger.

ERIC BERGER (Ars Technica): Yeah. Hi. In regards to the \$150 million for the commercial LEO development, can you talk about how this money would be spent and how you hope to convince Congress to fund it this year? Because I don't believe they funded a similar request in FY 2019.

ANDREW HUNTER: They did fund it at \$40 million. They probably had some skepticism as well, but I mentioned that we had several studies out with companies right now, about 12 studies that we're awaiting responses from for their proposals. Beyond that, I don't know what those studies will say and what concepts they will be putting forward. So these studies will include specifically their concepts detailing business plans and the viability of habitable platforms using Station or separate free-flyer structures. I'm not sure when those are meant to come in yet, but that's all I know.

ALLARD BEUTEL: Next, Grant Segall from Cleveland Plain Dealer.

GRANT SEGALL (The Plain Dealer): I'm here by NASA Glenn. I'm interested in what you said about consolidating wind tunnels. Is there any chance that NASA Glenn will either gain or lose wind tunnels or more of the testing work?

BRIAN DEWHURST: No. Sorry. So those wind tunnels in the past couple years have been funded out of multiple sources throughout our budget structure, and so we have—to make it easier to manage, we have consolidated the funding for the wind tunnels into the SSMS account. It does not change at all the operations, or we're not consolidating the tunnels

themselves. It's just we're putting all the money to run them into one place rather than having it spread throughout the agency.

ALLARD BEUTEL: Ken Chang, New York Times.

KEN CHANG (The New York Times): Hi. Thanks for a second question. For Earth Science, how much money would be saved by canceling PACE and the Pathfinder, and how much money are OCO-3 and DSCOVR costing?

BRIAN DEWHURST: So the PACE and CLARREO combined are about \$383¹ million in fiscal '19. The other two you mentioned combined are about \$10 million. I think it's 1.7 for DSCOVR.

ANDREW HUNTER: And 7.4 for OCO.

BRIAN DEWHURST: 7.4 for OCO.

ALLARD BEUTEL: Loren Grush, The Verge.

LOREN GRUSH (The Verge): Hi. Thanks for taking my question again. I'm also curious about—are there any plans to replace our current infrastructure at Mars in advance of the Mars Sample Return Mission such as new communication satellites that are aging and orbiter on Mars right now?

ANDREW HUNTER: Not at this time. Not in this budget.

ALLARD BEUTEL: James Dean, Florida Today.

JAMES DEAN (Florida Today): Hi. Thanks. I think you said that you were continuing to fund the second ML this year but didn't confirm this. Your proposed budget would continue that project next year, but there's no need for it, is there, if you are not using a Block 1B?

ANDREW HUNTER: Yeah. That is a recognized disconnect between congressional intent and our plan forward. We'll have conversations with Congress about that.

ALLARD BEUTEL: For the last couple of questions, back to Keith Cowing, NASA Watch.

KEITH COWING (NASA Watch): Okay. Clarification on my earlier question. Does this mean that by cutting the Office of STEM Engagement's budget to zero that everything that the Office of STEM Engagement currently does will no longer be done? Yes or no.

ANDREW HUNTER: Yes. It will not be done.

¹ IMPORTANT CORRECTION: The correct figure is about \$127 million in fiscal year 2020 -- \$110 million for PACE and \$17 million for CLARREO.

ALLARD BEUTEL: Next, Tariq Malik, Space.com.

TARIQ MALIK (Space.com): Yes. Thank you. You know, I had a question about the WFIRST space telescope itself, just because I know there was the attempt to cancel it in 2019 and then the funding, the \$321 million, was added back in there to kind of aim for that 2020's launch date. You know, in the language that was released today, it says both to terminate the telescope itself as well as to kind of delay any funding in it, pending a JWST completion. So is the goal with this request to unequivocally cancel the telescope for all time, or is there a window that is open there that would allow renewed funding in the 2021 pending a JWST launch at that time? Thank you.

ANDREW HUNTER: Yeah. I think that would be something we would revisit in subsequent budget cycles. It's just assumed canceled in this one, but by no means will science not be revisited if it's found to be a priority.

ALLARD BEUTEL: Okay. Eos Magazine.

KIMBERLY CARTIER (Eos Magazine): Hi. Thank you again for taking my question. Is there money included in this budget for CubeSats to be involved in the efforts to the Moon?

ANDREW HUNTER: Actually, we do have several CubeSats that will be on EM-1 on the launch of EM-1 that will be going to the lunar surface. I think there are about seven of them. That's just the only example I know right now off the top of my head.

ALLARD BEUTEL: And our last call, we will take from Marcia Smith, SpacePolicyOnline.

MARCIA SMITH (SpacePolicyOnline): Thanks so much. So you've displayed your budget in the format that you tried last year that Congress did not adopt, and it doesn't have a separate line for technology, as Congress requested. Are you still hoping to convince them to allow you to restructure the budget, and also are you still trying to eliminate the Space Technology Mission Directorate?

BRIAN DEWHURST: Hi, Marcia. So the structure that you're talking about, it is largely renaming what was the Exploration account us now the Deep Space Exploration Systems account, like we proposed last year, but the content is the same, which either way, that is the same thing for what was the Space Technology account, which we're proposing to rename the Exploration Technology account.

As for the renaming, that's not really a budget question. That's being worked through this year through our reorganization process. We have to notify Congress, and that sort of process is working its way through the government now.

ALLARD BEUTEL: Okay. There are no other questions in the queue, and so we will end this teleconference. As a reminder, all the budget material we've talked about is available on

nasa.gov/budget, and we will also have a recording, full recording of this. We'll post it at nasa.gov/budget as soon as possible. Also, please feel free to stay on the line. The operator will walk us through how to replay. You can hear it right not instantaneously pretty much after this call.

So thank you for joining us, and have a good afternoon.

OPERATOR: Thank you. To listen to a replay of today's conference, you may dial 1-800-879-6416. No passcode is required. Again, that phone number is 1-800-879-6416. The replay will be available through April 11th, 2019. And that concludes today's conference. Thank you all for participating. You may disconnect at this time.

IMPORTANT

CORRECTION: In response to a question from the New York Times about how much the agency could save with the proposed cancellation of the PACE and CLARREO Earth science missions, the answer provided was \$383 million. The correct figure is about \$127 million in fiscal year 2020 -- \$110 million for PACE and \$17 million for CLARREO.